

4.5 Hazard Area 5 - Bear Creek Valley

Bear Creek Valley is approximately 10 miles long and extends from the eastern end of the Y-12 National Security Complex to the confluence with Lower East Fork Poplar Creek on the west. The Bear Creek Valley watershed extends from the western boundary of the Y-12 complex to just west of state Highway 95, covering an area of approximately 1,000 acres. The watershed is bounded on the south by the Bethel Valley watershed, to the north by Pine Ridge and the City of Oak Ridge, and on the east by the Upper East Fork Poplar Creek watershed.

A 2-mile section of Bear Creek Valley immediately west of the Y-12 Plant includes several waste disposal facilities formerly used for disposal of radioactive and hazardous wastes generated from operations at Y-12 and throughout the ORR. These include: (1) the S-3 Site (including the S-3 Ponds); (2) the Oil Landfarm Area (including Oil Landfarm, Sanitary Landfill-1, the Boneyard/Burnyard, Hazardous Chemicals Disposal Area, and the Oil Landfarm Soils Containment Pad); and (3) the Bear Creek Burial Grounds, including numerous disposal pits and the DARA Solids Storage Facility. None of the sites are currently active, and all have either been capped with an engineered multi-layer cap or a soil cover. A leachate collection system has been installed at the Bear Creek Burial Grounds to collect leachate at several seeps that have subsequently developed. Water from the waste areas flows into Bear Creek. A groundwater divide exists at the S-3 Ponds, where surface and groundwater flow east into the Upper East Fork Poplar Creek watershed and west into the Bear Creek Valley watershed. The flow of Bear Creek is closely related to groundwater flow, and during rain events groundwater discharges to the creek and its tributaries.

The *Report on the Remedial Investigation of Bear Creek Valley at the Oak Ridge Y-12 Plant* (DOE 1997b) provides an extensive delineation of the nature and extent of contamination within the Bear Creek Valley watershed. The RI report is supplemented by a more detailed study of the Boneyard/Burnyard (DOE 1998b). COCs identified as posing environmental hazards due to migration from the disposal areas include nitrate, uranium, cadmium, and VOCs migrating through groundwater and surface water downgradient from the S-3 Site, uranium and mercury migrating from the Boneyard/Burnyard, and uranium and VOCs migrating out of the Bear Creek Burial Grounds via groundwater and surface water. In addition, dense non-aqueous phase liquids (DNAPLs) occur at the S-3 Site and the Bear Creek Burial Grounds; at these locations, DNAPLs are separated from the original source and have migrated along bedding planes and fractures in the Nolichucky shale. This migration has occurred to significant depth (400 ft) and resulted in dispersed droplets of DNAPLs left in fractures.

The *Record of Decision for Phase I Actions in Bear Creek Valley* (DOE 2001b) was issued in September 2001. Remedial actions were selected in this ROD to significantly reduce the release of contaminants from these waste areas into Bear Creek and its tributaries and to mitigate ecological and human health hazards from contaminated media within the Bear Creek Valley watershed. Remedy selection for the Bear Creek Burial Grounds waste units, S-3 Ponds Site Pathways 1 and 2, and final groundwater cleanup requirements for Bear Creek Valley were not included in the Phase I ROD, but were deferred to future CERCLA decision documents.

Actions under the Phase I ROD included the removal of primary source areas at the Boneyard/Burnyard, which was estimated to be the greatest contributor to uranium flux into Bear Creek, and hydraulic isolation of the remainder of this site. Remedial actions at the Boneyard/Burnyard were completed in 2003, and appear to be successful in reducing uranium flux to the creek. The Phase I ROD did not specify any concentration limits for contaminants in soil, but prescribed excavation of certain waste disposal areas based on physical boundaries. The selected remedy was designed to reduce the total mass of contaminants migrating from source areas to Bear Creek and its tributaries, and to limit the risk to hypothetical downstream users of surface water from Bear Creek not to exceed 1×10^{-5} ELCR. A Phase 2 ROD is planned to address contaminated materials in the Bear Creek Burial Ground, and a Phase 3 ROD is planned to document decisions for remediation of groundwater and sitewide ecological impacts.

Bear Creek Valley Current State:

The main contaminant sources in Bear Creek Valley include:

- The S-3 Ponds were used from the 1950s to 1980s for disposal of more than 2 million gallons of nitric acid solution per year resulting in a nitrate- and uranium-contaminated groundwater plume that has migrated about 3000 feet from the ponds and impacts Bear Creek. The S-3 Ponds were closed under the Resource Conservation and Recovery Act. The Phase I ROD included actions to remediate shallow groundwater emanating from the S-3 Ponds (designated Pathway 3), while other potential groundwater pathways would be addressed under a future decision.
- The Oil Landfarm Area consists of the Oil Landfarm, Sanitary Landfill 1, and the Boneyard/Burnyard, with the capped Hazardous Chemicals Disposal Area located on top of the Boneyard/Burnyard. The Oil Landfarm was used to dispose of organic wastes; contaminants of concern at this site include uranium, beryllium, and PCBs. Groundwater is contaminated with low levels of volatile organic compounds. Little information exists about the types of waste disposed of at the Sanitary Landfill, which has been closed and covered with a clay and soil cap. At the Boneyard/Burnyard contaminated debris and wastes were buried in trenches beginning in 1943. Contaminants (primarily uranium, and to a lesser extent volatile organic compounds, nitrates, mercury, and metals) flowed from the Boneyard/Burnyard into North Tributary 3. Remediation of the Boneyard/Burnyard was completed in 2003, and included excavation of approximately 80,000 yd³ of contaminated wastes and hydraulic isolation of areas of low-level contamination; more than 55,000 yd³ of this excavated volume was disposed at the EMWMF, while the remainder of the waste was consolidated and capped onsite.
- The Bear Creek Burial Grounds were used from the 1950s to the 1980s as the main solid waste disposal area for the Y-12 National Security Complex. Wastes were buried in trenches and covered with soil. The main contaminants are uranium, thorium, beryllium and volatile organic compounds. The inventory of uranium may exceed 40 million pounds.
- Shallow groundwater in the eastern end of Bear Creek Valley is contaminated with uranium and organics. Deep groundwater is also contaminated with organics associated with a DNAPL source. This groundwater contamination impacts surface water in the valley.

While not considered a source area for purposes of remedial action planning in Bear Creek Valley, another facility of major significance in this watershed is the Environmental Management Waste Management Facility (EMWMF). This facility was authorized under the *Record of Decision for the Disposal of Oak Ridge Reservation Comprehensive Environmental Response, Compensation, and Liability Act of 1980 Waste* (DOE1999b) for the disposal of wastes from ORR cleanup actions. EMWMF is an above-grade waste disposal facility, located in east Bear Creek Valley just west of the Y-12 National Security Complex. The facility began receiving waste in 2002. EMWMF was initially constructed to hold 400,000 yd³ of waste, and the design and construction is currently underway for an additional 800,000 yd³ capacity.

The White Wing Scrap Yard (WWSY, formerly identified as ORNL WAG 11) is located in the western portion of Bear Creek Valley. WWSY was used as a storage area for scrap and debris from ORNL, Y-12, and ETTP. Material disposed at this site included steel tanks, metal, glass, concrete, and miscellaneous industrial trash contaminated with radiological materials. Above-ground scrap and debris has been removed from the site under a series of interim measures, including the 1992 *Interim Record of Decision for the Oak Ridge National Laboratory, Waste Area Grouping 11, Surface Debris* (DOE 1992). Remediation requirements for remaining soil and other materials containing contaminants of concern above risk-based levels will be determined under a future CERCLA decision.

Primary contaminants of concern at Bear Creek Valley include: metals, radionuclides (e.g. uranium isotopes, technetium-99, cobalt-60), and organics in soil; VOCs, metals, radionuclides, and nitrates in groundwater and surface water; and PCBs in floodplain soil and sediments.

Life-Cycle Baseline for Bear Creek Valley:

Under the current baseline, near-term opportunities for major risk reduction in Bear Creek Valley include the hydraulic isolation and removal of hot spots from the Boneyard/Burnyard, which was completed in 2003. Baseline plans for other remedial actions in Bear Creek Valley, which are scheduled to be completed by 2015 under future CERCLA RODs, include the following:

- Planned actions at the Bear Creek Burial Grounds include hydraulic isolation through capping, diversion trenches, and in-situ treatment of high risk waste, and removal of the DARA Solids Storage Facility wastes for permanent disposal.
- Contaminated groundwater from the S-3 Pond seeps will be collected and treated in-situ. Groundwater remedies are expected to include measures such as alternate concentration limits, monitored natural attenuation, and/or technical impracticability waiver requests.
- Contaminated soil exceeding risk-based criteria will be excavated.
- Institutional controls will be maintained in perpetuity to control future land use, to restrict access to capped/closed waste disposal areas, and to prohibit onsite use of groundwater.

End State Vision for Bear Creek Valley:

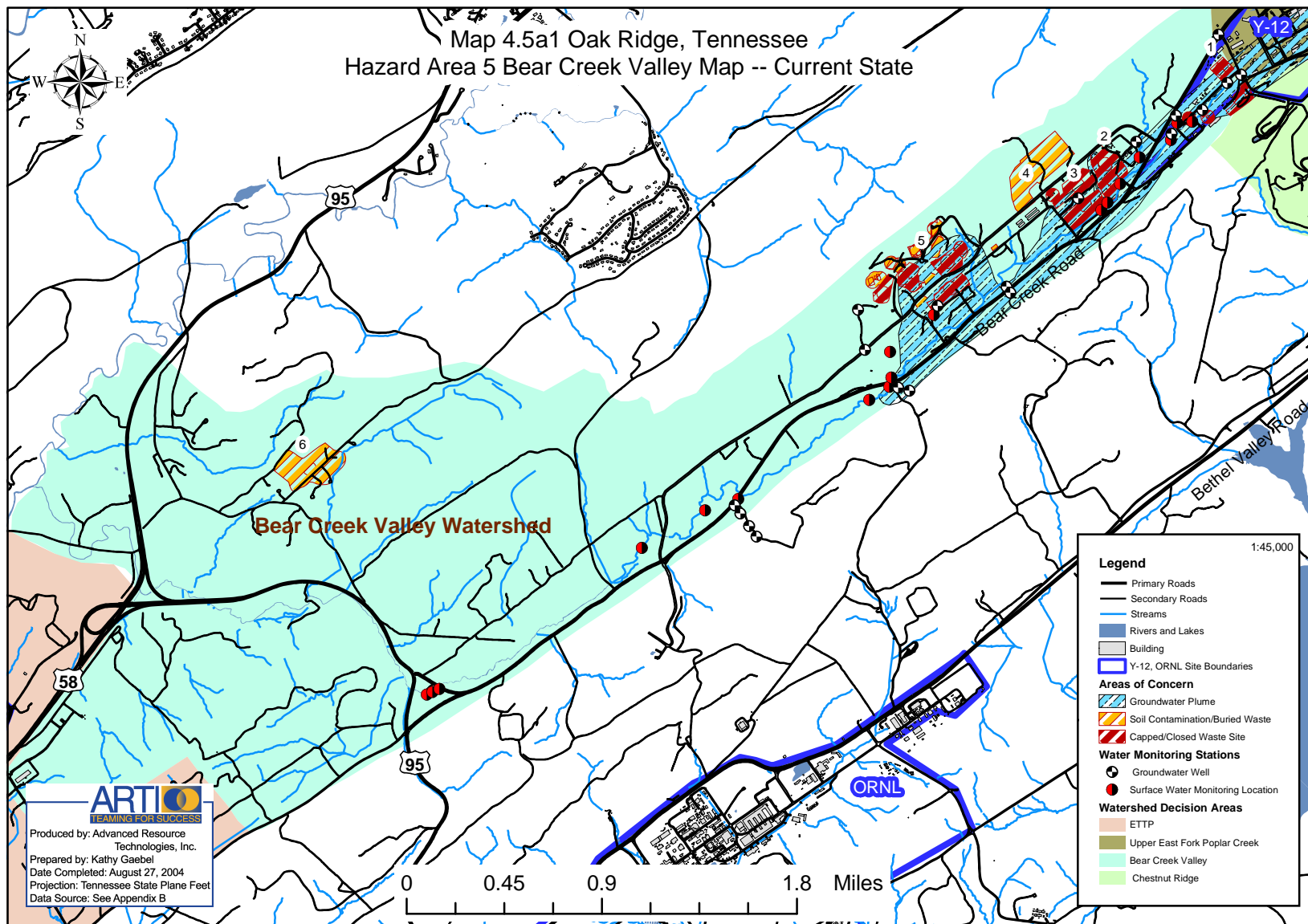
Current baseline plans for Bear Creek Valley are designed to support the planned industrial end use of the site, with areas dedicated to waste management. While criteria for remediation of most environmental media have not yet been developed for Bear Creek Valley, remediation

criteria ultimately will be derived to achieve an acceptably low level of risk to the future workers. Therefore, the actions planned under the life-cycle baseline are considered to be consistent with remedial actions designed solely on the basis of the end state vision. No specific variances have been identified for Bear Creek Valley.

Remedial actions selected under the Phase I ROD were limited to source reduction actions designed to reduce the overall flux of contaminants into Bear Creek in order to limit the potential risk to hypothetical downstream users of surface water from Bear Creek not to exceed 1×10^{-5} ELCR and also to attain AWQC. While remedial action decisions for waste units in the Bear Creek Burial Grounds and final remediation goals for groundwater have been deferred to future decisions, these decision ultimately will be designed to prevent unacceptable risk for the intended land use, i.e., continued industrial use in support of DOE/NNSA missions. The Phase I remedy identified three zones within Bear Creek Valley, each with a different future land use: Zone 1, the western portion of the watershed most distant from the Y-12 site, was considered suitable for unrestricted use; Zone 2, the middle portion of the watershed was restricted to recreational use and serves as a buffer zone between Zones 1 and 3; and Zone 3, which includes the eastern portion of the watershed containing the waste disposal areas, is restricted to DOE/NNSA-controlled industrial use. Subsequent to the Phase I ROD, NNSA has determined that all of Bear Creek Valley should remain under DOE/NNSA-control for potential future use in support of the Y-12 mission. Since current plans do not call for release of Zones 1 and 2 from DOE/NNSA control, remediation of Bear Creek surface water to levels suitable for residential or recreational use may be unnecessary to support the end state vision. However, the Phase I source reduction actions are largely completed, such that reconsideration of this decision would offer little benefit.

Maps of the Bear Creek Valley watershed under current and end state conditions are provided in Figures 4.5a1 and 4.5b1. Conceptual site models under current state and end state conditions are illustrated in Figures 4.5a2 and 4.5b2, respectively. The end state scenario for Bear Creek Valley is considered to be identical to the current baseline. Primary source areas at the Boneyard/Burnyard have already been removed and/or contained. While the absence of a decision regarding the Bear Creek Burial Grounds is a major uncertainty for Bear Creek Valley, both the baseline and end state scenarios assume that most waste will be managed in place through hydraulic isolation actions. Disposed wastes at the EMWMF and Bear Creek Burial Grounds will require active surveillance and maintenance programs to ensure the long-term integrity of cover systems; while the final cover systems will be designed to minimize requirements for active care, periodic maintenance may be required to minimize the potential for failure. Groundwater monitoring wells will require periodic maintenance and replacement at longer (assumed ~30 years) intervals. A long-term stewardship program will ensure the continuing protectiveness of the remedy, including continuing surveillance and maintenance. Since contaminants will remain on site above levels suitable for unlimited use and unrestricted exposure, a statutory review will be conducted at least every five years to ensure that the remedy continues to be protective of human health and the environment. The NNSA will retain ownership of the Bear Creek Valley Watershed and the remainder of the Y-12 National Security Complex for the foreseeable future. Future decisions will include any actions necessary for protection of groundwater and ecological resources. Such decisions are expected to be developed consistent with the ORR-wide strategies for these issues (DOE 2004a, 2004c).

Map 4.5a1 Oak Ridge, Tennessee
Hazard Area 5 Bear Creek Valley Map -- Current State



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TEAMING FOR SUCCESS

Produced by: Advanced Resource Technologies, Inc.
Prepared by: Kathy Gaebel
Date Completed: August 27, 2004
Projection: Tennessee State Plane Feet
Data Source: See Appendix B

Figure 4.5a1 Continued

Notes for Bear Creek Valley current state map:

1. S-3 Ponds – Closed under RCRA in 1988, but groundwater contamination that originated from this source is a continuing problem. S-3 Ponds functional area also includes other vicinity sites, including Spoil Area 1 and Contaminated Construction Soil Pile.
2. Boneyard/Burnyard – Remediation completed in 2003, via excavation and off-site disposal of contaminated materials, and hydraulic isolation of areas of low-level contamination.
3. Oil Landfarm Area – Includes Oil Landfarm, Oil Landfarm Soils Containment Pad, and Sanitary Landfill 1 – Oil Landfarm was closed under RCRA with a multi-layered cap in 1989; Sanitary Landfill 1 was closed under RCRA in 1985 with a clay cap and vegetative cover.
4. Environmental Management Waste Management Facility (EMWMF) – This engineered waste disposal facility for DOE-ORR CERCLA wastes was selected under a CERCLA ROD in 1999 and began operations in 2002.
5. Bear Creek Burial Grounds – Consists of numerous waste disposal facilities, including unlined earthen trenches used for disposal of solid and liquid wastes from the Y-12 Plant. Units A-North, A-South, C-West, Walk-In Pits, and Oil Retention Ponds 1 and 2 were previously closed under RCRA via capping with post-closure care and monitoring requirements. Other units have not been closed. Cumulatively, these facilities contain very large quantities of uranium wastes. Remedial action decisions for the Bear Creek Burial Grounds were not included in the scope of the Phase I ROD for Bear Creek Valley, but were deferred to a future decision.
6. White Wing Scrap Yard – Contaminated scrap and surface debris removed under previous CERCLA action in 1993; residual soil contamination remains.

Map 4.5b1 Oak Ridge, Tennessee
Hazard Area 5 Bear Creek Valley Map -- RBES

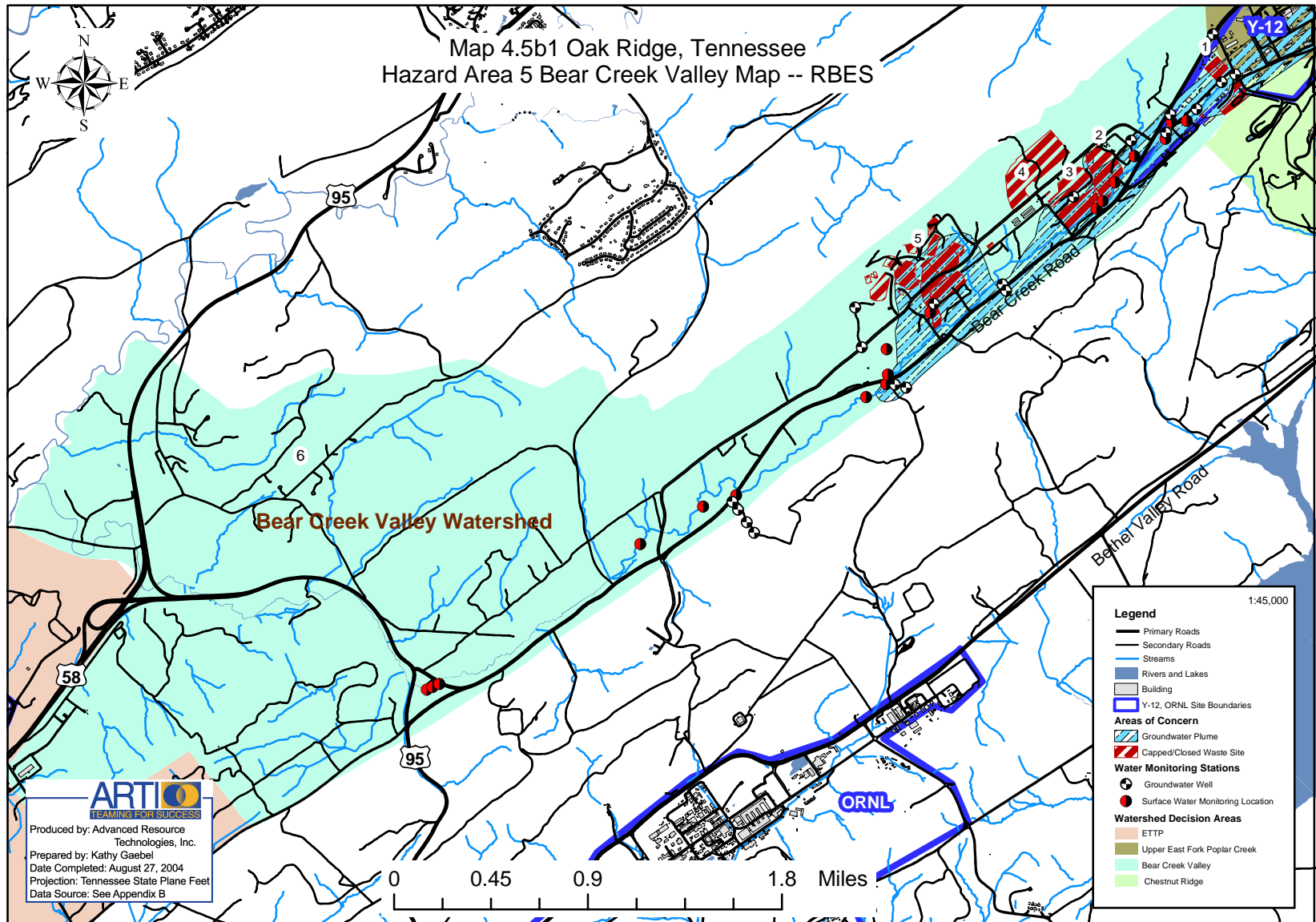


Figure 4.5b1 Continued

Notes for Bear Creek Valley End State map:

1. S-3 Ponds – Closed under RCRA in 1988, but groundwater contamination that originated from this source is a continuing problem.
2. Boneyard/Burnyard – Remediation completed in 2003, via excavation and off-site disposal of contaminated materials, and hydraulic isolation of areas of low-level contamination. More than 80,000 yd³ of waste was excavated, of which more than 55,000 yd³ was disposed at EMWMF and the remainder was consolidated and capped on-site. Environmental monitoring results to date indicate significant decrease in uranium flux to Bear Creek since completion of this action.
3. Oil Landfarm Area – Includes Oil Landfarm and Sanitary Landfill 1 – Oil Landfarm was closed under RCRA with a multi-layered cap in 1989; Sanitary Landfill 1 was closed under RCRA in 1985 with a clay cap and vegetative cover.
4. Environmental Management Waste Management Facility (EMWMF) – This engineered waste disposal facility for DOE-ORR CERCLA wastes began operations in 2002, and will be closed under a multi-layer engineered cap system when disposal capacity is reached. Two disposal cells with disposal capacity of 400,000 yd³ are currently in operation, and additional cells with disposal capacity of 800,000 yd³ are currently under design and scheduled for completion in 2005.
5. Bear Creek Burial Grounds – BCBG was not addressed under Phase I ROD for Bear Creek Valley, but will be addressed in future Phase II ROD. Wastes in all disposal units are assumed to be managed in place.
6. White Wing Scrap Yard – Contaminated scrap and surface debris removed under previous CERCLA action in 1993; residual soil contamination will be remediated to risk-based criteria to be determined in a future CERCLA decision.

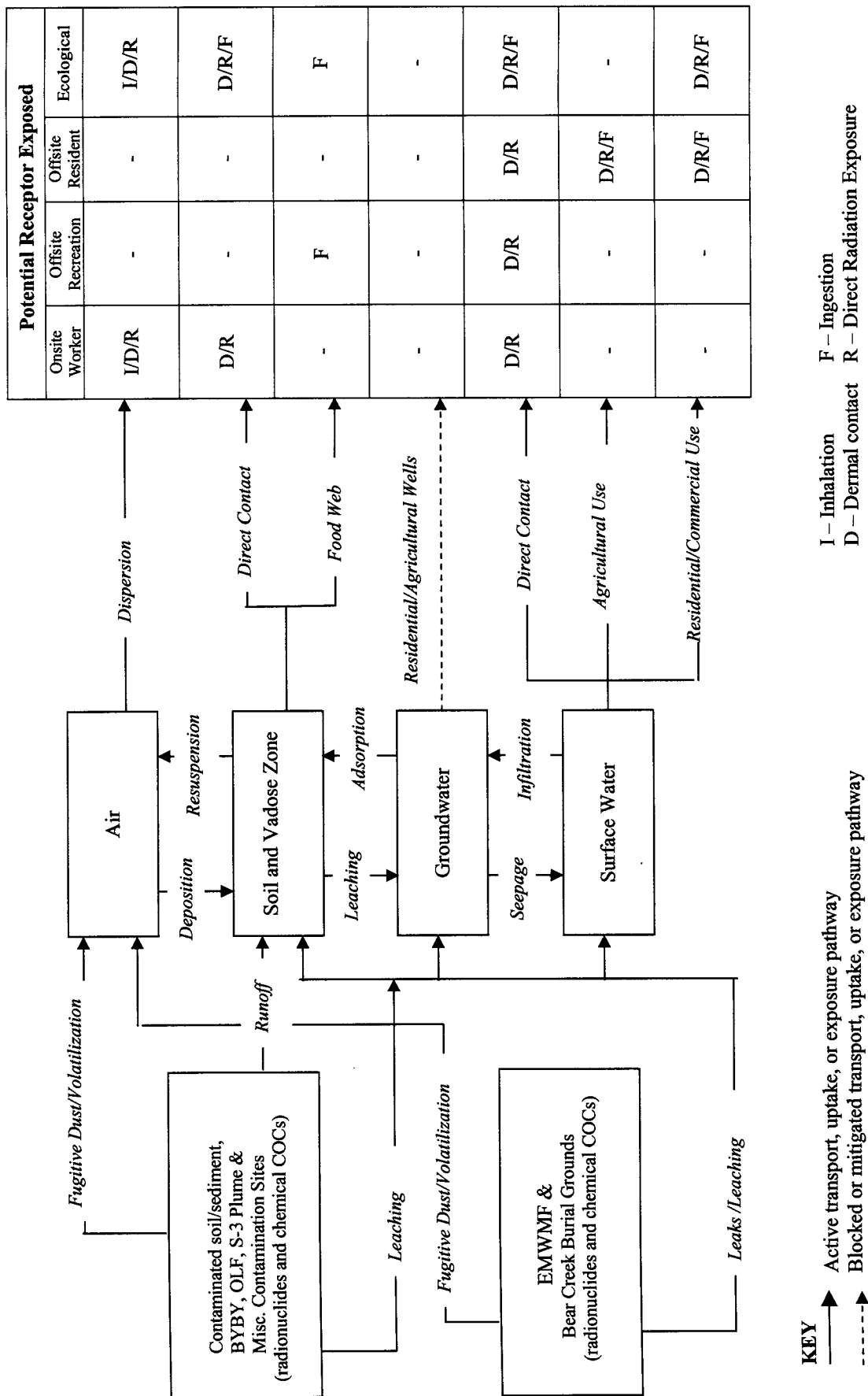


Figure 4.5a2, Conceptual Site Model – Hazard Area 5, Bear Creek Valley – Current State

Narrative:

Contaminant Sources:

Bear Creek Valley contains several of the major waste disposal sites within the ORR, which constitute the primary hazards and contaminant sources within this hazard area. The Environmental Management Waste Management Facility (EMWMF) was constructed specifically for disposal of CERCLA waste from throughout the ORR meeting waste acceptance criteria; construction and operation of this facility was performed in accordance with a CERCLA Record of Decision. EMWMF will be the permanent repository for the great majority of remediation wastes generated within the ORR. The Bear Creek Burial Grounds (BCBG) were used for disposal of large volumes of uranium wastes generated from Y-12 operations and throughout the ORR. No remediation decision has been made regarding the BCBG. Other contaminant sources within Bear Creek Valley which were addressed under the Phase I ROD include the Boneyard/Burnyard, the Oil Landfarm Area and the S-3 Site Plume. Remediation of these sources under Phase I actions was designed to significantly reduce the flux of uranium, nitrates, and other contaminants to Bear Creek surface water, with the intent to achieve a risk target to a hypothetical downstream receptor. Phase I actions included specific source removal actions, but did not include development of specific remediation criteria for soils or other media. The Phase I ROD subdivided the Bear Creek Valley into three Zones each with a different potential end use; however, DOE/NNSA has since determined that all of this property should remain under DOE/NNSA control for the foreseeable future in support of the Y-12 mission. Contaminants of concern include radionuclides (primarily uranium), nitrate, metals (Hg), VOCs, and PCBs.

Current State Exposure Pathways and Receptors:

Under current conditions, potentially complete exposure pathways for onsite workers include: inhalation of resuspended particulates or volatiles; and direct exposure to contaminants in soils, waste and surface water. While Bear Creek Valley is not normally accessible to recreational users, potentially complete exposure pathways to off-site recreationists include direct contact with surface water and ingestion of fish. Ecological receptors potentially may be exposed to contaminants in air, soil, surface water and the food chain. Potentially complete exposure pathways to offsite residents include direct contact with surface water after exiting the ORR, fish ingestion, and use of contaminated surface water for irrigation of home gardens. There is no current use of groundwater or surface water at Bear Creek Valley for residential, commercial, or agricultural purposes.

Figure 4.5a2, Conceptual Site Model – Hazard Area 5, Bear Creek Valley – Current State

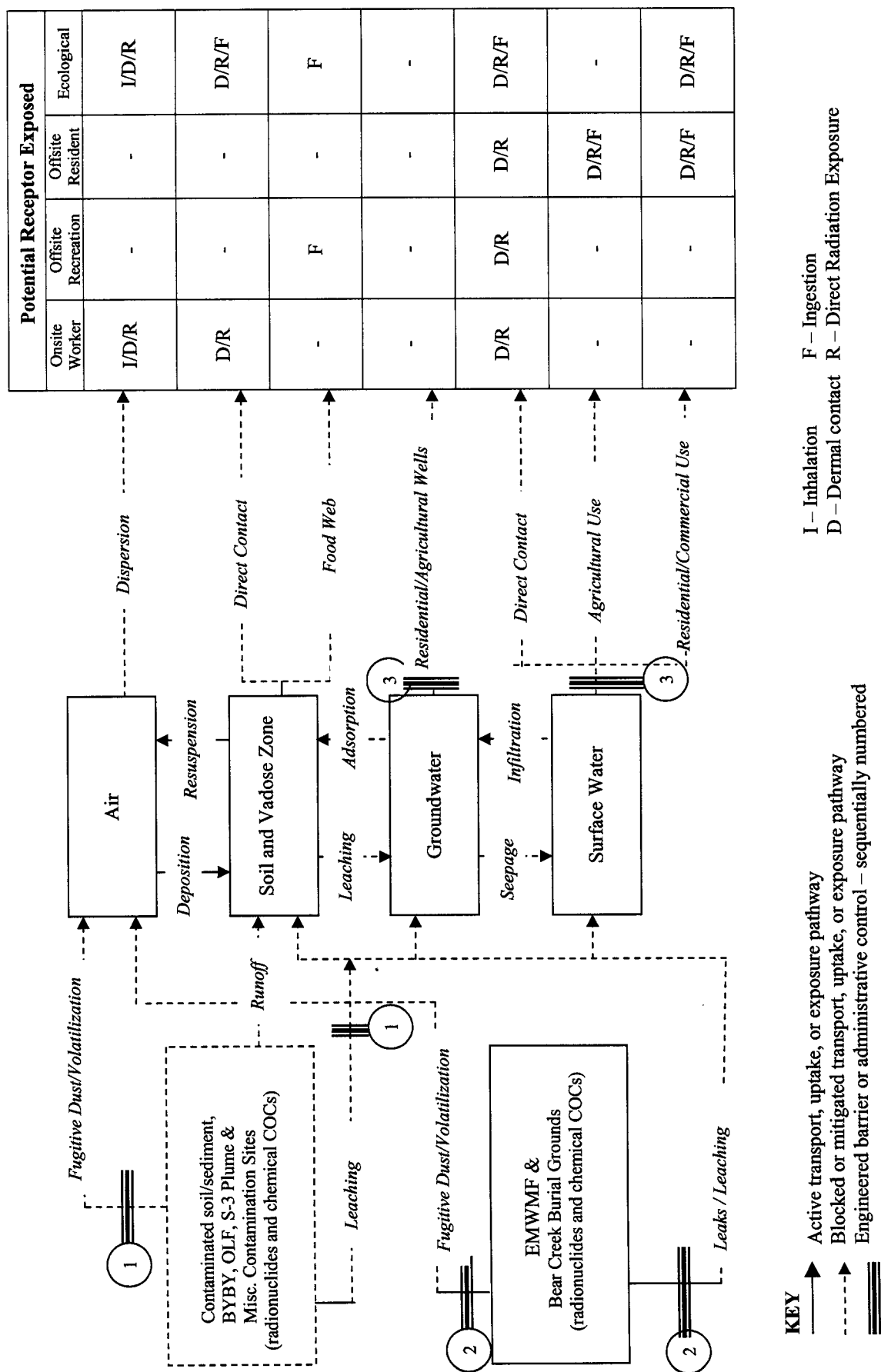


Figure 4.5b2, Conceptual Site Model – Hazard Area 5, Bear Creek Valley – End State

Narrative:

Contaminant Sources:

Under both current life-cycle baseline and end state conditions, Bear Creek Valley will remain under DOE/NNSA control for the foreseeable future. This area, located immediately west of the Y-12 main industrial complex, is largely undeveloped and has been used historically for waste management operations. Numerous waste management facilities within this area previously have been closed-in-place under RCRA regulations, and will require institutional controls in perpetuity. The most important waste disposal facilities expected to remain within Bear Creek Valley include the Bear Creek Burial Grounds and the EMWMF.

Remediation criteria for contaminants of concern in soil and other media have yet to be determined, but it is expected that such criteria will be risk-based and that any residual contamination below these criteria that will remain in soils, sediments, surface water and groundwater will not pose an unacceptable risk to future DOE/NNSA industrial workers. Institutional controls will include restrictions on future groundwater use.

End State Barriers/Interventions:

The steps taken to mitigate or remove these hazards are as follows:

1. Primary source material (contaminated soil and wastes) at the Boneyard/Burnyard has been excavated and disposed at the EMWMF; this site was determined to be the greatest contributor to uranium flux to Bear Creek. Other less highly contaminated materials at the Boneyard/Burnyard were consolidated in place beneath a soil cover. One of the three primary components of the S-3 Ponds Site plume also was addressed under the Phase I ROD. Other contaminant source areas not addressed in the Phase I ROD, which remain within Bear Creek Valley, include the remaining portions of the Oil Landfarm Area, Bear Creek Burial Grounds, and the S-3 Ponds Site pathways 1 and 2. These areas will be addressed in future decisions, but it is likely that remedial actions will continue to be focused on reducing the potential for offsite migration of contaminants in the surface water of Bear Creek.
2. Major waste disposal areas, including the Bear Creek Burial Grounds and the EMWMF, are expected to remain at their present locations, dedicated to permanent waste management. Most portions of the BCBG have been previously closed-in-place under RCRA, with multi-layer caps currently in place. The EMWMF also will be closed-in-place with a multi-layer cover system upon completion of its operational life-cycle. In each case, the engineered containment systems will preclude unacceptable exposures to workers or releases of contaminants to the environment above levels of concern.
3. Future land use within Bear Creek Valley will be restricted to DOE/NNSA controlled industrial use, with emphasis on permanent waste disposal operations and prohibitions on groundwater and surface water use. Long-term stewardship and institutional controls will ensure continuing protectiveness of the remedy. Surveillance and maintenance will include monitoring of surface water and groundwater, with periodic maintenance and replacement of groundwater wells and ongoing maintenance of capped areas as required.

Since contaminants will remain on site above levels suitable for unlimited use and unrestricted exposure, a statutory review will be conducted at least every five years to ensure that the remedy continues to be protective of human health and the environment. These reviews will evaluate any failure of remedial measures and the sustainability of the remedy. Potential failure modes could include breaches of capping/containment systems, unauthorized use of groundwater, or unauthorized land use.

Figure 4.5b2, Conceptual Site Model – Hazard Area 5, Bear Creek Valley – End State